INSECT INJURIES TO FOREST PRODUCTS.

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CHARACTER AND EXTENT OF INJURY.

The detrimental and destructive work of insects which cause serious losses in commercial woods, barks, nuts, etc., consists of burrows or galleries excavated by the young and matured forms of beetles and a few other kinds of insects.

Round timber, rough lumber, and other crude products are seriously injured by pinhole and wormhole defects caused by a class of wood-boring beetles and grubs.

Seasoned rough and dressed lumber and finished wood material is damaged or completely destroyed by a class of so-called powder post borers, which convert the woody tissue into a mass of fine dust or powder.

Construction timbers and other wood material utilized in buildings, bridges, railroad construction, mining, etc., are often infested by wood-boring grubs, powder post borers, white ants, and other insects, to their serious detriment or destruction.

Stored oak and hemlock bark for tanning purposes is, under certain conditions, seriously damaged or destroyed by insects which infest the inner or "flesh" parts and convert them into a fine powder.

Medicinal barks, roots, and leaves are also bored or eaten by drug beetles, causing injuries which, while not necessarily destroying the medicinal qualities, are detrimental to the commercial value of such material.

From the writer's personal investigations of this subject in different sections of the country, the damage to forest products of various kinds from this cause seems to be far more extensive than is generally recognized. Allowing a loss of 5 per cent on the total value of the forest products of the country, which the writer believes to be a conservative estimate, it would amount to something over $30,000,000 annually. This loss differs from that resulting from insect damage to natural forest resources in that it represents more directly a loss of money invested in material and labor.

KNOWLEDGE NECESSARY TO PREVENTION OF LOSSES.

In dealing with the insects mentioned, as with forest insects in general, the methods which yield the best results are those which relate directly to preventing attack. In order to meet with the best success, however, it is necessary to have a complete knowledge of the insects which cause the injuries and the conditions which are attractive to them or otherwise favor their attack, as well as those which are unattractive or unfavorable.

The insects have two objects in their attack; one is to obtain food, the other is to prepare for the development of their broods. Different species of insects have special periods during the season of activity (March to November) when the adults are on the wing in search of suitable material in which to deposit their eggs. Some species which fly in April will be attracted to the trunks of recently felled pine trees or to piles of pine sawlogs from trees felled the previous winter. They are not attracted to any other kind of timber, because they can live only in the bark or wood of pine, and only in that which is in the proper condition to favor the hatching of their eggs and the normal development of their young. As they fly only in April, they can not injure the logs of trees felled during the remainder of the year. There are also oak insects, which attack nothing but oak; hickory insects, cypress insects, spruce insects, and so on, which have different habits and different periods of flight and require special conditions of the bark and wood for depositing their eggs or for the subsequent development of their broods. Some of these insects have but one generation in a year, others have two or more, while some require more than one year for their complete development and transformation. Some species deposit their eggs in the bark or wood of trees soon after they are felled or before any perceptible change from the normal living tissue has taken place; other species are attracted only to dead bark and dead wood of trees which have been felled or girdled for several months; others are attracted to dry and seasoned wood; while another class will attack nothing but very old dry bark or wood of special kinds and under special conditions. Thus, it will be seen how important it is for the practical man to have a knowledge of such of the foregoing facts as apply to his immediate interest in the manufacture or utilization of a given forest product, in order that he may, with the least trouble and expense, adjust his business methods to meet the requirements for preventing losses.

DISTINCTIVE CHARACTER OF INSECT INJURIES.

The work of different kinds of insects, as represented by special injuries to forest products, is the first thing to attract attention, and the distinctive character of this work is easily observed, while the insect

responsible for it is seldom seen, or it is so difficult to determine by the general observer, from descriptions or illustrations, that the species is rarely recognized. Fortunately, the character of the work is often sufficient in itself to identify the cause and suggest a remedy, and, in this paper, primary consideration is given to this phase of the subject.

AMBROSIA OR TIMBER BEETLES.

The characteristic work of this class of wood-boring beetles is shown in figures 43, 44, and 45. The injury consists of pinhole and stained-wood defects in the sapwood and heartwood of recently felled or girdled trees, sawlogs, pulpwood, stave and shingle bolts, green or

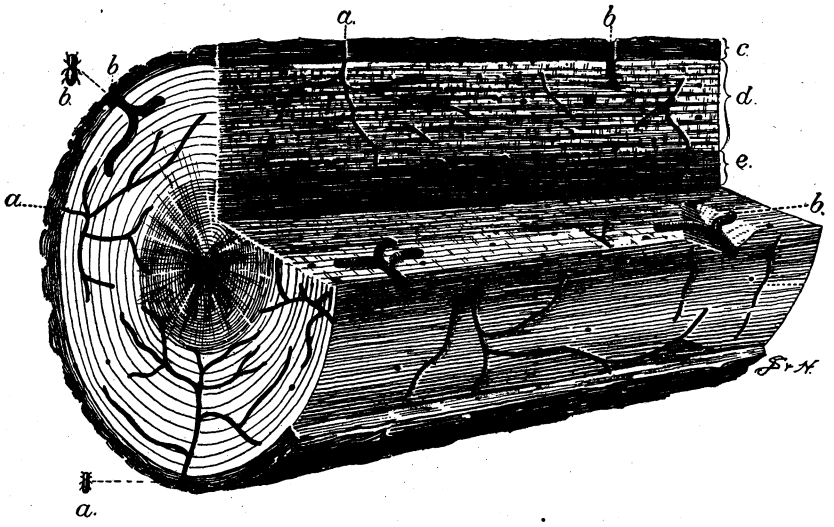

FIG. 43.—Work of ambrosia beetles in tulip or yellow poplar wood: *a*, work of *Xyleborus affinis* and *Xyleborus inermis*; *b*, *Xyleborus obesus* and work; *c*, bark; *d*, sapwood; *e*, heartwood. (Original.)

unseasoned lumber, and staves and heads of barrels containing alcoholic liquids. The holes and galleries are made by the adult parent beetles to serve as entrances and temporary homes or nurseries for the development of their broods of young, which feed on a kind of fungus growing on the walls of the galleries. The growth of this ambrosia-like fungus is induced and controlled by the parent beetles, and the young are dependent upon it for food. The wood must be in exactly the proper condition for the growth of the fungus in order to attract the beetles and induce them to excavate their galleries; it must have a certain degree of moisture and other favorable qualities which usually prevail during the period involved in the change from living, or normal, to dead or dry wood; such a condition is found in recently felled trees, sawlogs, or like crude products.

There are two general types or classes of these galleries—one in

which the broods develop together in the main burrows (figs. 43 and 44), the other in which the individuals develop in short separate side

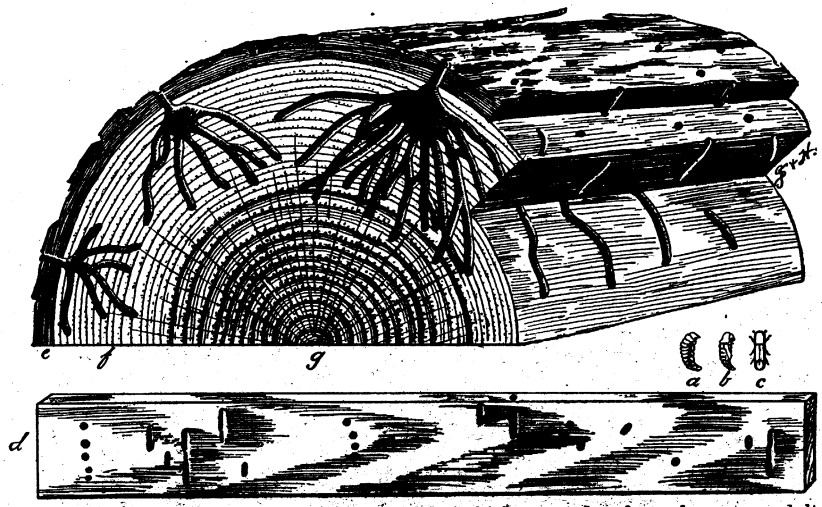

FIG. 44.—Work of ambrosia beetle, *Xyleborus celsus*, in hickory wood: *a*, larva, *b*, pupa; *c*, adult beetle, natural size; *d*, character of work in lumber cut from injured log; *e*, bark; *f*, sapwood; *g*, heartwood. (Original.)

chambers extending at right angles from the primary gallery (fig. 45). The galleries of the latter type are usually accompanied by a distinct staining of the wood, while those of the former are not.

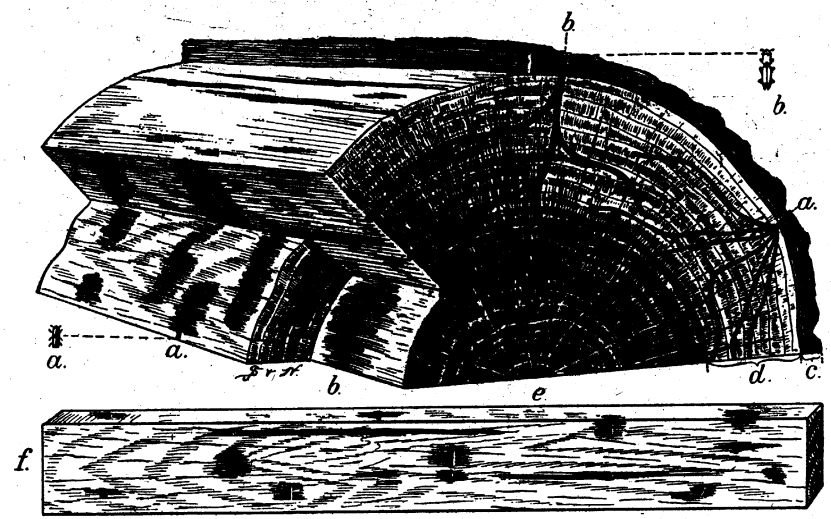

FIG. 45.—Work of ambrosia beetles in oak: *a*, *Monarthrum mali* and work; *b*, *Platypus compositus* and work; *c*, bark; *d*, sapwood; *e*, heartwood; *f*, character of work in lumber from injured log. (Original.)

The beetles responsible for this work are cylindrical in form, apparently with a head (the prothorax) half as long as the remainder of the

body (figs. 43, *a*, and 45, *a*). North American species vary in size from less than one-tenth to slightly more than two-tenths of an inch, while some of the subtropical and tropical species attain a much larger size. The diameter of the holes made by each species corresponds closely to that of the body, and varies from about one-twentieth to one-sixteenth of an inch for North American, and to one-eighth of an inch for the tropical species.

ROUND-HEADED BORERS.

The character of the work of this class of wood and bark-boring grubs is shown in figure 46. The injuries consist of irregular flattened or nearly round wormhole defects in the wood which sometimes result in the destruction of the valuable parts of wood or bark material.

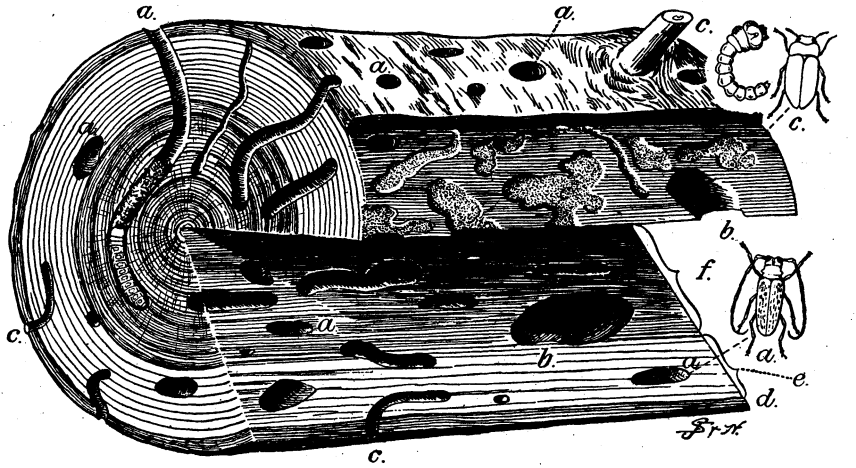

FIG. 46.—Work of round-headed and flat-headed borers in pine: *a*, work of round-headed borer, "sawyer," *Monohammus* sp., natural size; *b*, *Ergates spiculatus*; *c*, work of flat-headed borer, *Buprestis*, larva and adult; *d*, bark; *e*, sapwood; *f*, heartwood. (Original.)

The sapwood and heartwood of recently felled trees, sawlogs, poles, posts, mine props, pulpwood, and cordwood, also lumber or square timber with bark on the edges, and construction timber in new and old buildings, are injured by wormhole defects, while the valuable parts of stored oak and hemlock tanbark and certain kinds of wood are converted into worm dust. These injuries are caused by the young or larvæ of long-horned beetles. Those which infest the wood hatch from eggs deposited in the outer bark of logs and like material, and the minute grubs hatching therefrom bore into the inner bark, through which they extend their irregular burrows for the purpose of obtaining food from the sap and other nutritive material found in the plant tissue. They continue to extend and enlarge their burrows as they increase in size, until they are nearly or quite full grown. They then enter the wood and continue their excavations deep into the sapwood

or heartwood until they attain their normal size. They then excavate pupa cells in which to transform into adults, which emerge from the wood through exit holes in the surface.

This class of borers is represented by a large number of species. The adults, however, are seldom seen by the general observer unless cut out of the wood before they have emerged. Many of them fly at night, while others are so nearly the color of the bark on which they rest that they are difficult to find. The holes made by these borers vary in size from very minute to more than an inch in diameter, but the intermediate sizes are most common.

FLAT-HEADED BORERS.

The work of flat-headed borers is only distinguished from that of the preceding by the broad, shallow burrows and the much more oblong form of the exit holes. In general, the injuries are similar and affect the same class of products, but they are of much less importance. The adult forms are flattened, metallic-colored beetles, and represent many species, of various sizes.

TIMBER WORMS.

The character of the work done by the borers of this class is shown in figure 47. The injury consists of pinhole defects in the sapwood and heartwood of felled trees, sawlogs, and like material which have

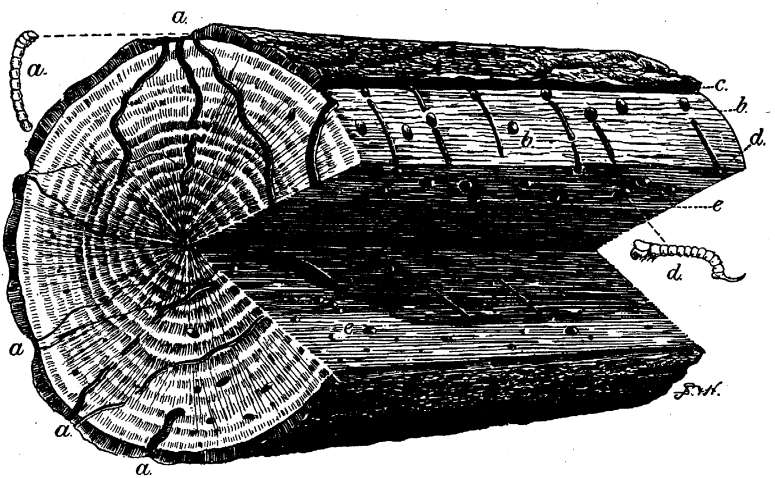

FIG. 47.—Work of timber worms in oak: *a*, work of oak timber worm, *Eupsalis minuta;* *b*, barked surface; *c*, bark; *d*, sapwood timber worm, *Hylocœtus lugubris*, and work; *e*, sapwood. (Original.)

been left in the woods or in piles in the open for several months during the warmer seasons. Stave and shingle bolts and closely piled oak lumber and square timbers also suffer from injury of this kind. These

injuries are made by elongate, slender worms or larvæ which hatch from eggs deposited by the adult beetles in the outer bark, or, where there is no bark, just beneath the surface of the wood. At first the young larvæ bore almost invisible holes for a long distance through the sapwood and heartwood, but as they increase in size the same holes are enlarged and extended until the larvæ have attained their full growth. They then transform to adults and emerge through the enlarged entrance burrows. The work of these timber worms is distinguished from that of the timber beetles by the greater variation in the size of holes in the same piece of wood; also by the fact that they are not branched from a single entrance or gallery, as are those made by the beetles.

POWDER POST BORERS.

The character of work of this class of insects is shown in figures 48, 49, 50, and 51. The injury consists of closely placed burrows packed with the borings or a completely destroyed or powdered condition of

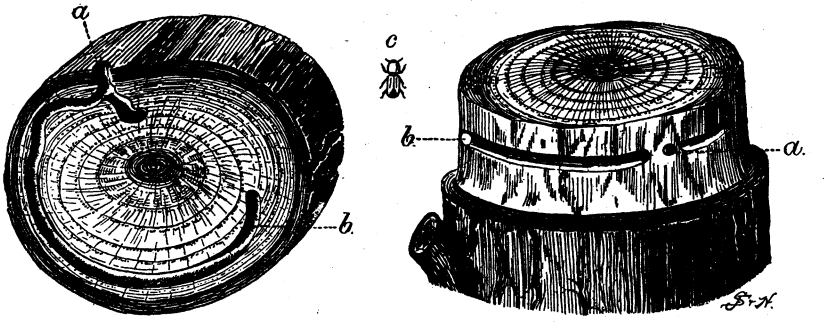

FIG. 48.—Work of powder post beetle, *Sinoxylon basilare*, in hickory poles, showing transverse egg galleries excavated by the adult: *a*, entrance; *b*, gallery; *c*, adult. Natural size (original).

the wood of seasoned products, such as lumber, crude and finished handle, cooperage, and wagon stock, furniture, and inside finish wood-

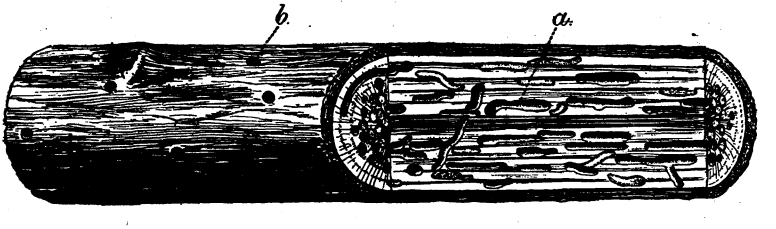

FIG. 49.—Work of powder post beetle, *Sinoxylon basilare*, in hickory pole: *a*, character of work by larvæ; *b*, exit holes made by emerging broods. (Original.)

work in old buildings, as well as in many other crude or finished and utilized woods. This is the work of both the adults and young stages

of some species, or of the larval stage alone of others. In the former, the adult beetles deposit their eggs in burrows or galleries excavated for the purpose, as in figures 48 and 49, while in the latter (figs. 50 and 51) the eggs are deposited on or beneath the surface of the wood. The grubs complete the destruction by boring through the solid wood in all directions and packing their burrows with the powdered wood. When they are full grown they transform to the adult and emerge from the injured material through round holes in the surface. Some of the species continue to work in

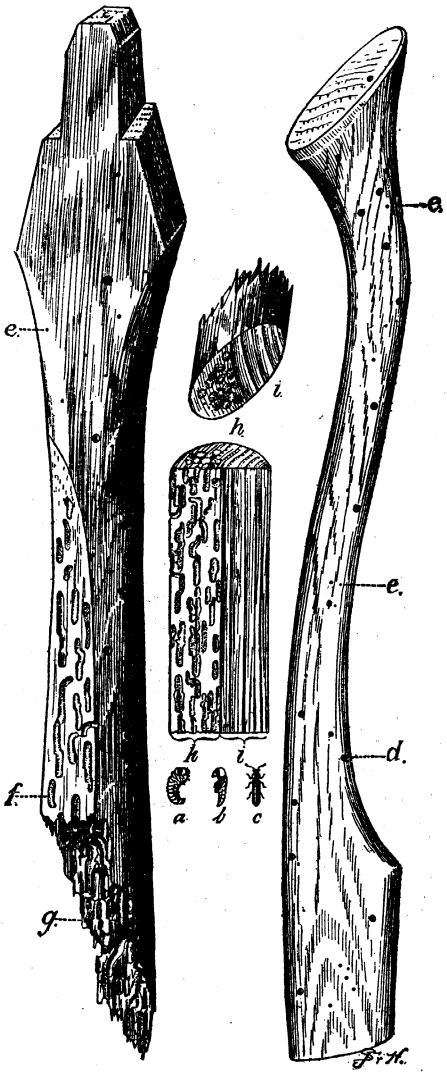

FIG. 50.—Work of powder post beetle, *Lyctus striatus*, in hickory handles and spokes: *a*, larva; *b*, pupa; *c*, adult, natural size; *d*, exit holes; *e*, entrance of larvæ (vents for borings are exits of parasites); *f*, work of larvæ; *g*, wood, completely destroyed; *h*, sapwood; *i*, heartwood. (Original.)

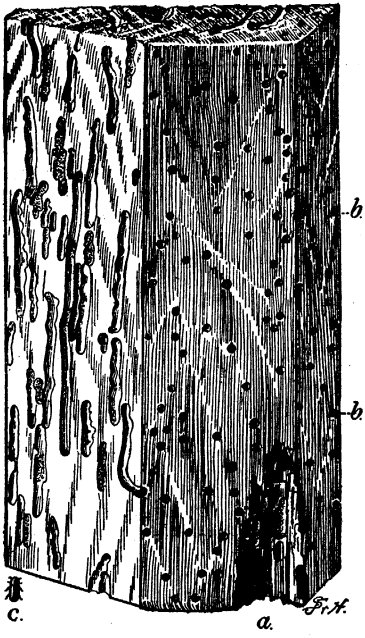

FIG. 51.—Work of powder post beetle, *Xyletinus paltatus*, in old pine flooring: *a*, work of larvæ; *b*, exit holes made by emerging broods; *c*, adult, natural size. (Original.)

the same wood until many generations have developed and emerged, or until every particle of wood tissue has been destroyed and the available nutritive substance extracted.

WHITE ANTS, OR TERMITES.

The character of the work of white ants, or termites, in wood is shown in figure 52. It consists of burrows, galleries, and tunnels of greatly varying sizes, and of every conceivable shape, extended in all directions through the wood. A peculiar character is the complete destruction of the inner portion of the wood, while slight or no evidence is shown on the exposed surface. In this work these insects employ a kind of earthy matter mixed with macerated wood to cover or roof in such parts of the galleries as would otherwise be exposed to the light; also to cover their paths over the surface of stone, iron, or uninjured wood, where inside tunnels are not made, to protect them from light and from their enemies as they travel from place to place to visit or extend their burrows and nests.

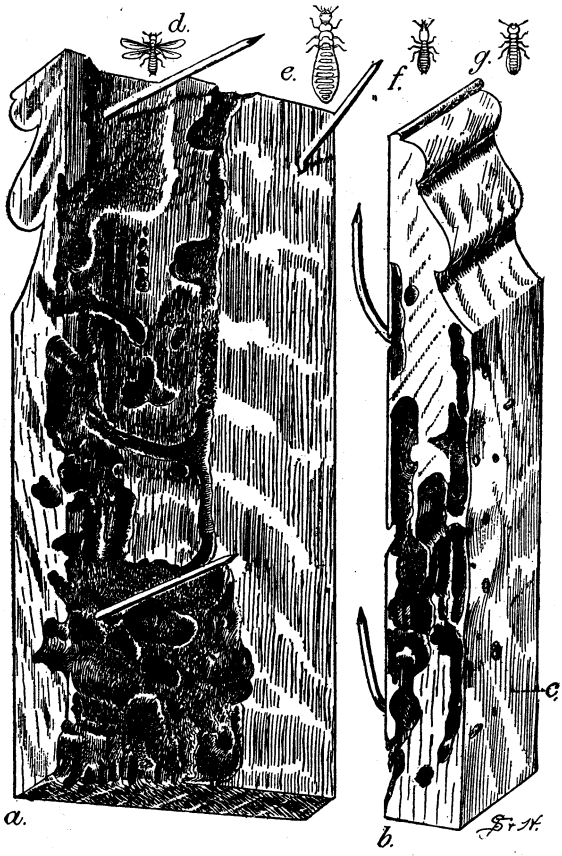

FIG. 52.—Work of white ant, or termite, *Termes flavipes*, in sound and dry red oak molding from door casing: *a*, inner portion; *b*, longitudinal section; *c*, outer surface; *d*, male; *e*, female; *f*, soldier; *g*, worker, natural size. (Original.)

The injuries to forest products, both crude and finished, consist of a partial or complete destruction of the infested material. Under certain conditions greater damage and loss is caused than by the work of any other class of insects. A great variety of products is affected, such as round and square timbers left for some time next to the ground, posts and poles set in the ground, railroad ties, bridge timbers, and lumber in the bottom of stacks; and these insects are especially destructive to the underpinning, flooring, and all other wooden parts of buildings which are readily accessible to the little destroyers. The excavations are made by the insects for the purpose of obtaining food and to serve as habitations and nurseries for the great number of individuals which occupy them.

These insects are not true ants, but resemble them somewhat in size and general appearance. They correspond in their social habits to ants and bees in that each colony includes workers, soldiers, males and females (winged or wingless), and a single royal pair.[a]

BLACK ANTS.

The work of the true ants in wood somewhat resembles that of white ants, and is done for the same or similar purposes and under similar conditions, but is much less common or injurious. It usually consists in the extension of the work or damage started by other wood-boring insects, through the galleries of which the black ant gains entrance to the inner wood, which is sometimes honeycombed.

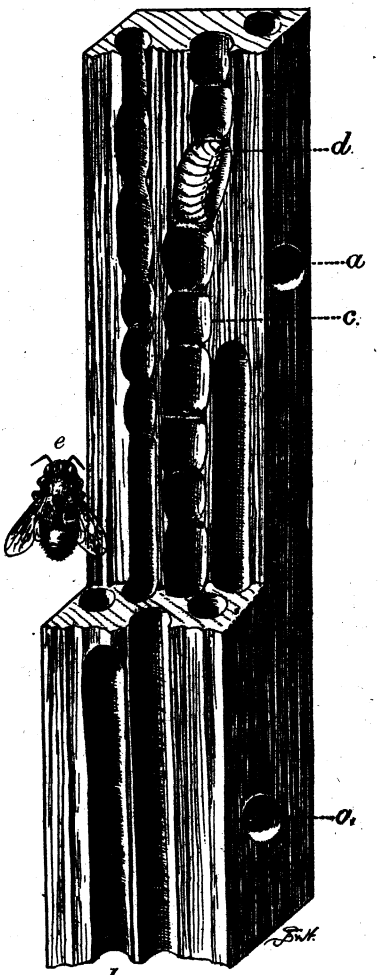

FIG. 53.—Work of carpenter bee, *Xylocopa orpifex*, in redwood lumber from San Jose, Cal.: *a*, entrance; *b*, galleries; *c*, cells; *d*, larva; *e*, adult—slightly reduced. (Original.)

CARPENTER BEES.

The work of this class of wood-boring bees is shown in figure 53. The injury consists of large augerhole-like tunnels in exposed solid dry wood of buildings and other structures. It is most common in soft woods, such as pine, poplar, redwood, and the like, the latter being especially liable to attack in California and the Southwest.

NUT WEEVILS AND THEIR ALLIES.

The characteristic work of this class of insects is a mined or mealy condition of the kernel or inner parts, the surface being pierced by round holes and otherwise injured or destroyed. The loss results from the worthless condition of the infested material as an article of commerce, as food, and for planting, whether naturally or artificially.

Many kinds of insects are responsible for injuries of this kind, such as weevils and other beetles, caterpillars of moths, and gall flies. In most cases where the inner portion of nuts or seeds is injured by weevils, the

[a] For further information on these insects, see article by C. L. Marlatt, in Bulletin No. 4, new series, of the Bureau of Entomology.

eggs are deposited in the young pods, so that the entrance burrows made by the minute young larvæ are completely hidden before the nuts are matured. After the larvæ in nuts complete their growth they bore their way out and enter the ground to pass the winter, and transform to the adult the next season. In certain kinds of seeds the transformation to the adult takes place within.[a]

DRUG BEETLES.

Injury by this class of enemies to certain medicinal products of the forest consists of the honeycombed, sieve-like, or powdered condition of certain kinds of barks, roots, stems, leaves, and seeds. The insects responsible for the work belong to the class of true powder post borers, and have similar habits.

CONDITIONS FAVORABLE FOR INSECT INJURY.

CRUDE PRODUCTS.

ROUND TIMBER WITH BARK ON.—Newly felled trees, sawlogs, telegraph poles, posts, and like material, cut in the fall and winter and left on the ground or in close piles during a few weeks or months in the spring and summer, are especially liable to injury by ambrosia beetles (figs. 43, 44, and 45), round and flat-headed borers (fig. 46), and timber worms (fig. 47), as are also trees felled in the warm season and left for a time before working up into lumber. The proper degree of moisture found in freshly cut living or dying wood, and the period when the insects are flying, are the conditions most favorable for attack. This period of danger varies with the time of the year the timber is felled and with different kinds of trees. Those felled in late fall and winter will generally remain attractive to ambrosia beetles and the adults of round and flat-headed borers during March, April, and May. Those felled in April to September may be attacked in a few days after they are felled, and the period of danger may not extend over more than a few weeks. Certain kinds of trees felled during certain months and seasons are never attacked, because the danger period prevails only when the insects are flying; on the other hand, if the same kinds of trees are felled at a different time, the conditions may be most attractive when the insects are active, and they will be thickly infested and ruined.

The presence of bark is absolutely necessary for infestation by most of the wood-boring grubs, since the eggs and young stages must occupy the outer and inner portions before they can enter the wood. Some ambrosia beetles and timber worms will, however, attack barked logs, especially those in close piles and otherwise shaded and protected from rapid drying. The sapwood of pine, spruce, fir, cedar,

[a] For further information on these insects, see article by F. H. Chittenden, Bulletin No. 44, Bureau of Entomology, pp. 24–43.

cypress, and like soft wood is especially liable to injury by ambrosia beetles, while the heartwood is sometimes ruined by a class of round-headed borers known as sawyers. Yellow poplar, oak, chestnut, gum,

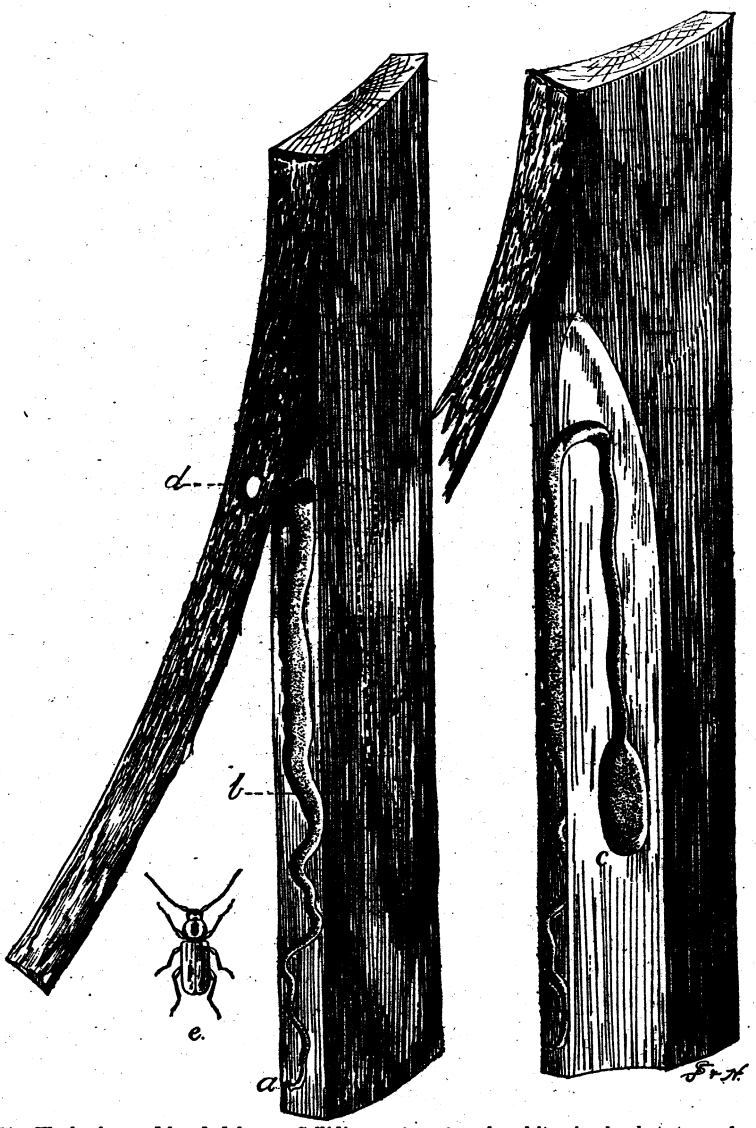

FIG. 54.—Work of round-headed borer, *Callidium antennatum*, in white pine bucket staves from New Hampshire: *a*, where egg was deposited in bark; *b*, larval mine; *c*, pupal cell; *d*, exit in bark; *e*, adult, slightly reduced. (Original.)

hickory, and most other hardwoods, are, as a rule, attacked by species of ambrosia beetles, sawyers, and timber worms different from those infesting the pines, there being but very few species which attack both.

Mahogany and other rare and valuable woods imported from the

Tropics to this country in the form of round logs, with or without the bark on, are commonly damaged, more or less seriously, by ambrosia beetles and timber worms. It would appear, from the writer's investigations of logs as received at the mills in this country, that the principal damage is done during a limited period from the time the trees are felled until they are placed in the fresh or salt water for transportation to the shipping points. If, however, the logs are loaded on the vessel direct from the shore, or if not left in the water long enough to kill the insects, the latter will continue their destructive work during transportation to this country and after they arrive until cold weather ensues or the logs are converted into lumber. It was also found that a thorough soaking in sea water, while it usually killed the insects at the time, did not prevent subsequent attack by both foreign and native ambrosia beetles; also, that the removal of the bark from such logs previous to their immersion did not render them entirely immune. Indeed, it was found that those with the bark off were attacked more than those with it on, owing, doubtless, to the greater amount of saline moisture absorbed and retained by the bark.

From the foregoing it will be seen that some requisites for preventing insect injuries to round timber are:

(1) To provide for as little delay as possible between the felling of the tree and its manufacture into rough products. This is especially necessary with trees felled from April to September in the region north of the Gulf States, and from March to November in the latter, while the late fall and winter cutting should all be worked up by March or April.

(2) If the round timber must be left in the woods or on the skidways during the danger period, every precaution should be taken to facilitate rapid drying of the inner bark, by keeping the logs off the ground, in the sun, or in loose piles; or else the opposite extreme should be adopted, and the logs kept in water.

(3) The immediate removal of all of the bark from poles, posts, and other material which will not be seriously damaged by checking or season cracks.

(4) To determine and utilize the proper months or seasons to girdle or fell different kinds of trees. Bald cypress in the swamps of the South are girdled in order that they may die and in a few weeks or months dry out and become light enough to float. This method has been extensively adopted in sections where it is the only practicable one by which the timber can be transported to the sawmills. It is found, however, that some of these girdled trees are especially attractive to several species of ambrosia beetles (figs. 43, 44, and 45), round-headed borers (fig. 46), and timber worms (fig. 47), which cause serious injury to the sapwood or heartwood, while other trees girdled at a different

time or season are not injured. This suggested to the writer the importance of experiments to determine the proper time to girdle trees to avoid losses, and they are now being conducted on an extensive scale, in cooperation with prominent cypress operators in different sections of the cypress-growing region.

SAPLINGS.—Saplings, including hickory and other round hoop poles and similar products, are subject to serious injuries and destruction by round and flat-headed borers (fig. 46) and certain species of powder post borers (figs. 48 and 49) before the bark and wood are dead or dry, and also by other powder post borers (fig. 50), after they are dried and seasoned. The conditions favoring attack by the former class are those resulting from leaving the poles in piles or bundles in or near the forest for a few weeks during the season of insect activity, and by the latter, from leaving them stored in one place for several months.

STAVE AND SHINGLE BOLTS.—These are attacked by ambrosia beetles (figs. 43–45) and the oak timber worm (fig. 47, *a*), which, as has been frequently reported, cause serious losses. The conditions favoring attack by these insects are similar to those mentioned under "Round timber." The insects may enter the wood before the bolts are cut from the log, or afterwards, especially if the bolts are left in moist, shady places in the woods in close piles during the danger period. If cut during the warm season, the bark should be removed and the bolts converted into the smallest practicable size and piled in such a manner as to facilitate rapid drying.

HANDLE AND WAGON STOCK IN THE ROUGH.—The crude material from which this class of products is manufactured is especially liable to injury by ambrosia beetles and round-headed borers, and, during the warmer seasons, special precaution is required to prevent damage. The conditions favoring attack of the round logs and bolts are the same as with other round timber. Hickory and ash in the round with the bark on are almost certain to be greatly damaged if the winter and spring cuttings are held over a few weeks after the middle of March or first of April.

PULPWOOD AND CORDWOOD.—Pulpwood is injured by ambrosia beetles and round-headed borers, and cordwood by the latter. The conditions favoring attack are those resulting from close piling, and leaving in the woods, or in shady damp places, from a few weeks after the first of April to the first of August. Material of this kind is sometimes riddled with holes, or converted into "sawdust," if left in close piles for a few months during the summer. This damage can be avoided, to a great extent, by placing the sticks of wood in triangular, or crib, piles immediately after they are cut from the tree—a common practice in the South. This facilitates rapid drying and renders the

wood immune. Peeling and splitting of the wood before it is piled is also desirable for the same purpose.

UNSEASONED PRODUCTS IN THE ROUGH.

Freshly sawed hardwood lumber placed in close piles during warm, damp weather in July and September presents especially favorable conditions for injury by ambrosia beetles (figs. 43, *a*, and 45, *a*.) This is due to the continued moist condition of such material. Heavy 2-inch or 3-inch stuff is also liable to attack even in loose piles with lumber sticks. An example of the latter was found in a valuable lot of mahogany lumber of first grade, the value of which was reduced two-thirds by injury from a native ambrosia beetle. Numerous complaints have been received from different sections of the country of this class of injury to oak, poplar, gum, and other hardwoods. In all cases it is the moist condition and retarded drying of the lumber which induces attack; therefore any method which will provide for the rapid drying of the lumber, before or after piling, will tend to prevent losses. It is important that heavy lumber should, as far as possible, be cut in the winter and piled so that it will be well dried out before the middle of March.

Lumber and square timber with the bark on the edges or sides often suffer from injuries by flat and round-headed borers hatching from eggs deposited in the bark of the logs before they are sawed or after the lumber has been sawed and piled. One example of serious damage and loss was reported in which white pine staves for paint buckets and other small wooden vessels, which had been sawed from small logs and the bark left on the edges, were attacked by a round-headed borer, the adults having deposited their eggs in the bark after the stock was sawed and piled. The character of the injury is shown in figure 54, page 392.

Another example was reported from a manufacturer in the South, where the pieces of lumber which had a strip of bark on one side were seriously damaged by the same kind of borer, the eggs having been deposited in the logs before sawing or in the bark after the lumber was piled. If the eggs are deposited in the logs and the borers have entered the inner bark, or the wood, before sawing, they may continue their work regardless of methods of piling; but if such lumber is cut from new logs and placed in the pile while green, with the bark surface up, it will be much less liable to attack than if piled with the bark down. This liability of lumber, with bark edges or sides, to be attacked by insects suggests the importance of the removal of the bark to prevent damage, or, if this is not practicable, the lumber with the bark on the sides should be piled in open, loose piles with the bark up, while that with the bark on the edges should be placed on the outer edges of the pile, exposed to the light and air.

A moist condition of lumber and square timber, such as results from close or solid piles with the bottom layers on the ground, or on a foundation of old decaying logs, or near decaying stumps and logs, offers especially favorable conditions for the attack of white ants.

SEASONED PRODUCTS IN THE ROUGH.

DRY LUMBER.—Dry lumber in stacks or storage is liable to injury by powder post borers (fig. 50). The conditions favoring attack are: (1) The presence of a large proportion of sapwood, as in hickory, ash, and similar woods; (2) material which is two or more years old or that which has been kept in one place for a long time; (3) access to old infested material. Therefore such lumber should be frequently examined for evidence of the presence of these insects. This is always indicated by fine flour-like powder on or beneath the piles, or otherwise associated with such material. All infested material should be at once removed and the infested parts destroyed by burning.

DRY COOPERAGE, WAGON, AND HANDLE STOCK.—These are especially liable to attack and serious injury by powder post borers (fig. 50), under the same or similar conditions as in the case of dry lumber.

FINISHED OR UTILIZED PRODUCTS.

TIMBERS AND OTHER WOODWORK IN NEW AND OLD BUILDINGS.—These are often injured by powder post borers (fig. 50), or white ants (fig. 52). If by the former in new structures, it indicates that infested material was used in the structure and that after being thus introduced the insects continued to breed and extend the injuries, regardless of paint and varnish or other external treatment which would otherwise prevent attack. If the trouble occurs in old buildings it is usually due to a large proportion of sapwood in the frame timbers, flooring, and other parts, which, owing to the age of such material, is rendered especially attractive to certain classes of powder post borers. After such wood is once infested, the insects continue to breed and extend their work for many years, or until all the sapwood is converted into powder. Figure 51 illustrates an example of pine flooring in an old barn which was damaged by one species of this class of insects.

The conditions in new or old buildings favorable for attack by white ants (fig. 52) are decayed or moist wood in the underpinning and foundation timbers which are near the ground, or the location of buildings in the vicinity of decaying wood of any kind in which the insects are breeding. After a building is once infested, however, the destructive work is extended into sound and dry wood. Old logs and stumps are favorite breeding places for these insects, from which they may travel or fly to a considerable distance to reach suitable places to extend

their work; therefore, it is important that all such material should be removed previous to the construction of buildings to prevent danger. The creosote treatment of frame timbers would doubtless prevent the attack of powder post borers.

WOODWORK IN WAGONS, FURNITURE, ETC.—This is often seriously damaged or destroyed by powder post borers (fig. 50), which are introduced by the use of infested wood, in which they continue to work regardless of paint and subsequent external treatment.

STAVES AND HEADINGS OF BARRELS CONTAINING ALCOHOLIC LIQUIDS.—These are liable to attack by ambrosia beetles (figs. 43, *a*, and

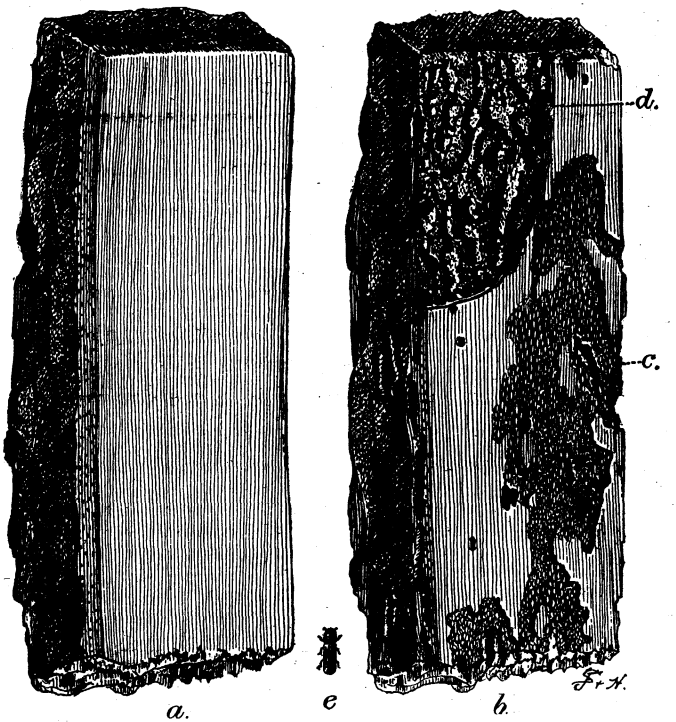

FIG. 55.—Work of the hemlock tanbark destroyer, *Dinoderus substriatus: a*, bark less than three years old, uninjured; *b*, bark over three years old; *c*, surface of inner bark eaten by adults; *d*, inner portion destroyed by larvæ and adults; *e*, adult, natural size. (Original.)

45, *a*), which are attracted by the moist condition, and possibly by the peculiar odor of the wood, resembling that of dying sapwood of trees and logs, which is their normal breeding place. There are many examples on record of serious losses of liquors from leakage caused by the beetles boring through the staves and headings of barrels and casks in cellars and storerooms.

The condition, in addition to the moisture of the wood, which is favorable for the presence of the beetles is proximity to their breeding

places, such as the trunks and stumps of recently felled or dying oak, maple, apple, and other hardwood or deciduous trees; lumber yards, sawmills, freshly cut cordwood from living or dead trees, and forests of hardwood timber. Under such conditions the beetles occur in great numbers, and, if the storerooms and cellars in which the barrels are kept are damp, poorly ventilated, and readily accessible to them, serious injury is almost certain to follow.

FIG. 56.—Work of round-headed borer, *Phymatodes variabilis*, in oak tanbark: *a*, adult. (Original.)

TANBARK.—Favorable conditions for insect attack and injury to tanbark (figs. 55 and 56) are found in that which is over three years old from the time it is taken from the tree. This suggests at once a simple and practical method of preventing losses—that of labeling the different lots, or piles, with the year the bark was peeled, and then utilizing it before it is old enough to be in danger of attack. While it is a common practice for tanners and dealers to keep a record of the age for other reasons, the utilization of the bark within three years is by no means universal, as was demonstrated by the writer's investigation at one tannery, where $50,000 to $75,000 worth of old hemlock bark was found to have been rendered almost worthless, while the remainder of the bark in the yards, which was less than three years old, showed no damage whatever.